Space Weather Technical Forecast

Issued on Wednesday, 08 May 2024 at 01:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of X-class flares (R3 - Strong radio blackouts) throughout. Slight chance of G1/Minor storm intervals due to CMEs (Coronal Mass Ejections).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is at Moderate levels. AR3663 in the northwest of the visible disc has produced numerous M-class flares in the last 24 hours, reaching a peak of M8.2 at 07/1630 UTC. There are seven sunspot regions on the visible disc. AR3663 in the northwest remains the most active flaring region, retaining a delta spot configuration. AR3664 is the largest region on the disc, in the southwest, and has developed further with a number of strong spots in evidence along with delta spot configurations. Classification of this complex grouping is somewhat complicated by the proximity of AR3668 lying just to the east, though this is designated a simpler bipolar region at this time. The remaining sunspots on the disc are smaller, stable and magnetically simple.
No significant Coronal Mass Ejections (CME) with an Earth bound component have been observed this period.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 were at predominantly slightly elevated to elevated levels resulting from the connection to the HSS of a couple of positive coronal holes. Speeds peaked briefly at strong levels (602km/s at 07/0150 UTC). Density remained below average through the period. The Interplanetary Magnetic Field, Bt, remained at weak levels. The peak was around 6nT at the start of the period. The north-south component, Bz, was also at weal levels in a range +6/-4 nT. Phi angle was mostly positive (away from the sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at normal background levels. High energy electron flux (greater than 2MeV) observed at GOES16 remained at largely background levels. The associated 24-hour fluence was well below the Active threshold. Observed fluence at 08/0001 UTC was 1.67e6 integrated pfu on a steady trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast to continue with occasional M-class flares expected and a chance of isolated X-flares, principally from AR3663 and AR3664 in the northwest and southwest respectively.

Solar Wind / Geomagnetic Activity: There are multiple potentially Earth-directed CMEs in the forecast period, although confidence is low due to a lack of coronagraph imagery in recent days. Of these, the majority, if not all are expected to pass above or below Earth orbit, most likely limiting any impacts to glancing blows. Earth is under the influence of a HSS (High speed stream) from CH35/+ and CH33/+ with solar winds expected to peak at elevated levels on Day 1

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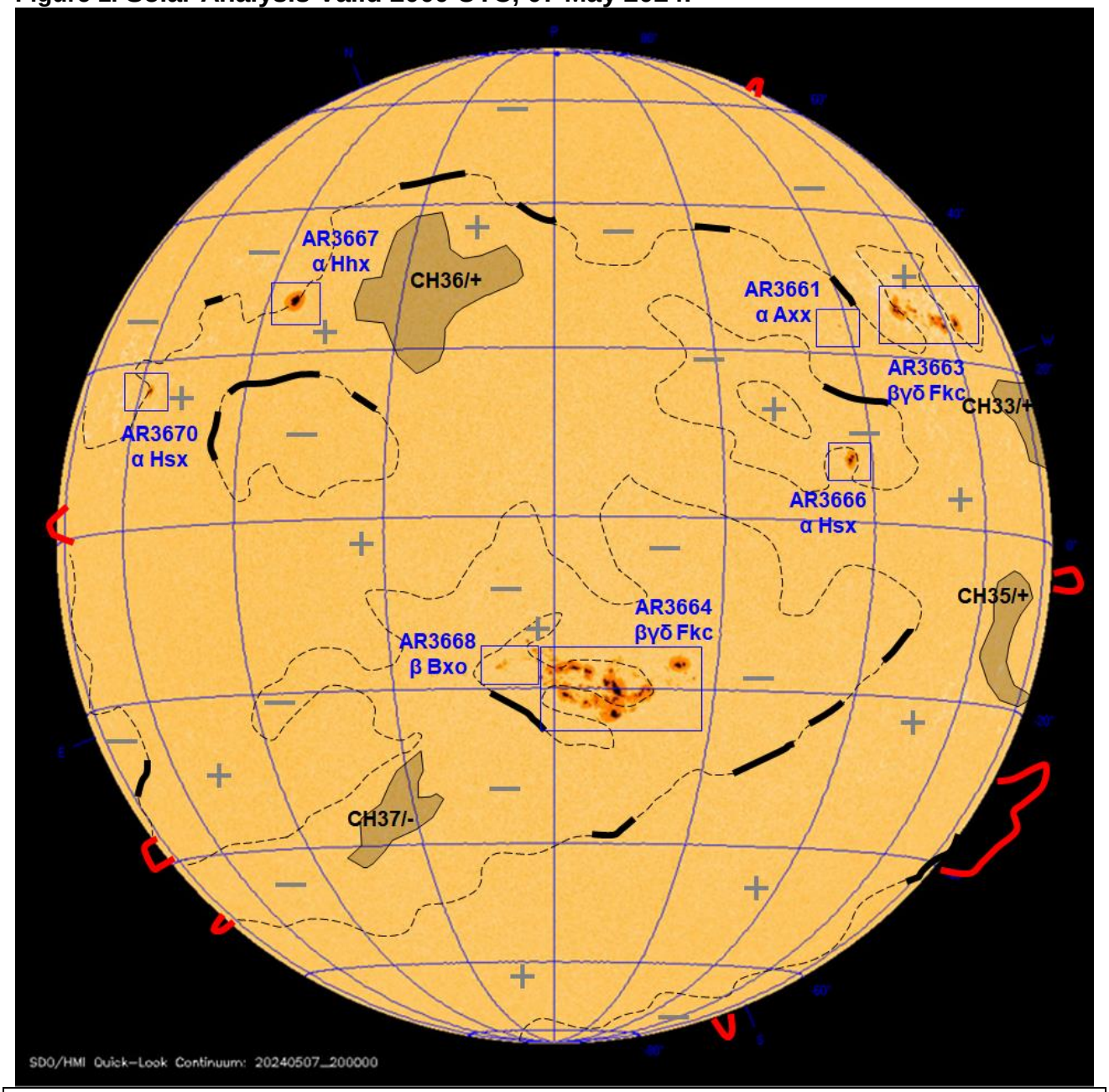
(08 May) before slowly declining between Days 2-4 (09-11 May) towards slightly elevated or slow-ambient levels.
Geomagnetic activity should generally remain at Quiet to unsettled levels through the period, with a slight chance of Minor Storm (Kp5) intervals on all days, given the potential for peripheral CME enhancements.

Energetic Particles / Solar Radiation: High energy proton flux is likely to remain at background levels through the period. There is a chance for an S1/Minor Storm or greater event throughout from AR3663 and AR3664.
High energy electron flux is forecast to be at background to moderate levels throughout, with associated fluence expected to remain well below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 2000 UTC, 07 May 2024.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are multiple potentially Earth-directed CMEs in the guidance period, and confidence is low due to a recent lack of SOHO imagery. A largely northward directed CME followed the M9.0 flare of AR3663 early on 05 May, with modelling giving a possible glancing interaction at the very start of this period. A second, again mostly northbound, CME in association with the X4.5 flare on 06 May has the potential to be partially Earth-directed with any impact early on Day 2 (09 May). This may arrive at a similar time to a small CME from a filament eruption in the southwest disc that left the Sun late on 05 May. Limited imagery continues to give a challenging analysis of a potential third Earth-bound CME with coronal dimming in the southeast disc near AR3664 around 05/1500 UTC that led to a CME and this may arrive at the end of Day 3 (10 May).

Earth remains firmly connected to a HSS from coronal holes CH33/+ and CH35/+, with mostly elevated solar winds. The coronal holes while broadly persistent are noticeably larger than the previous rotation with elevated solar winds that should be easing in the coming days towards slightly elevated or slow-ambient levels. The combination of declining HSS and potential CME influence through the period, as well as gaps in imagery, results in lower than average confidence for detail of geomagnetic activity in coming days.

Geomagnetic activity probably mostly remaining Quiet to Unsettled through the guidance period, with a chance of Minor Storm (Kp5) intervals on all days, given the potential for peripheral CME enhancements.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
04/0715	Partial	AR3663	NW	601 km/s	08/0000 UTC	Glance possible
06/1056	Partial	AR3663	NW	811 km/s	09/0000 UTC	Glance possible
06/0251	Partial	Filament	SE	323 km/s	10/2100 UTC	Glance possible

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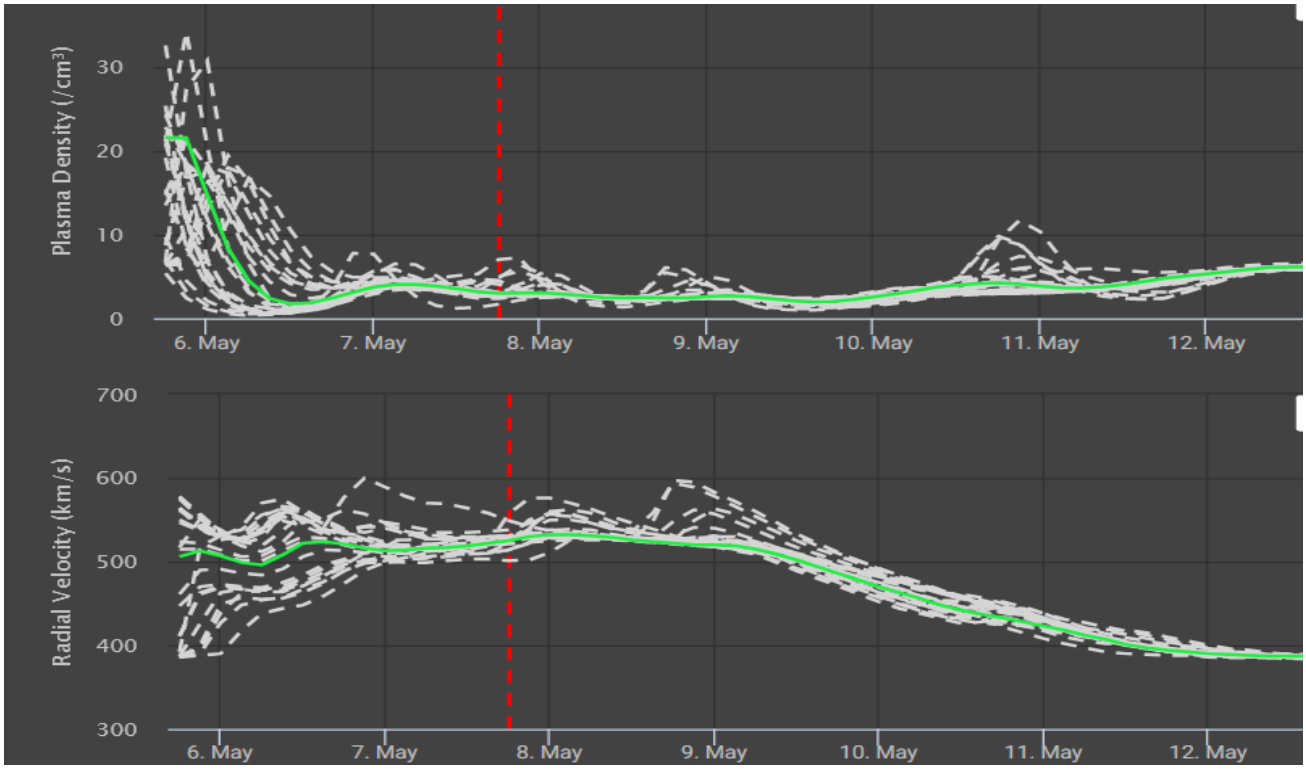
Figure 2: Latest MOSWOC Enlil ensemble forecast.



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Radio Blackouts - X-Ray Flares:

Solar activity is Moderate with the largest flare observed an M8.2 at 07/1630 UTC and numerous lower peaking M-class flares, from AR3663 and AR3664.

Seven sunspot regions feature on the visible disc. The most active is AR3663, located in the northwest, displaying a large and complex intermediate spot with a delta configuration. AR3664 in the southwest is the largest active region on the disc. There has been marked growth in the region in recent days, and the emergence of a number of strong spots and multiple delta configurations. The eastern periphery of the region lies close to AR3668 and appears magnetically linked. Solar activity originating from this region has started to increase

The remaining sunspots on the disc are generally smaller, stable and magnetically simple. Both AR3663 and AR3664 remain on the visible disc for a good part this guidance period although the former region is due to rotate over the northwest horizon late in the period. Far-sided helioseismographs indicate a number of returning regions over the eastern horizon in the coming days that may supplement the present risk of significant flares should they persist.

Moderate to High solar activity is predicted pending further developments, with occasional M-class flares and a slight chance of isolated X-class flares throughout, principally from AR3663 and perhaps increasingly from AR3664.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	95	95	90	90
Very Active	R3 to R5 X Class	No	40	30	30	20

Figure 3: GOES-16/18 X-Ray flux.

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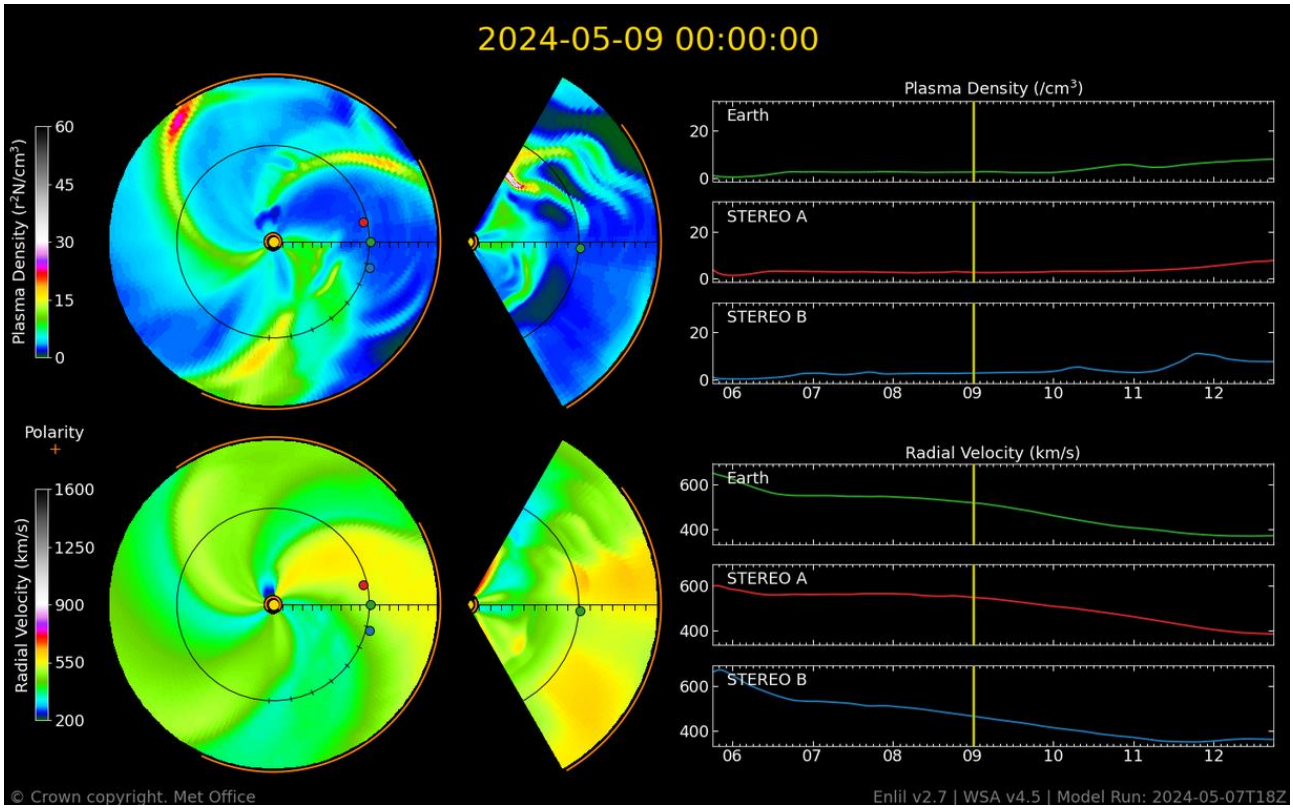
Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV) observed at GOES-18 has been at background levels and is most likely to remain that way through the period. However, there is a chance of an S1/Minor Storm or greater event occurring throughout, from both AR3663 and AR3664 as they transit westward into a more favourable location, although recent flares have so far failed to trigger any proton response.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	25	25	30	30
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Latest Met Office ENLIL output.



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High Energy Electrons Event (≥ 2MeV):
High energy electron flux is at normal background levels. Likely CME and coronal hole influences through the period are expected to limit electron flux to background to moderate levels on all days.
Overall, the 24 hour integrated electron fluence is forecast to remain well below the Active (1e8 integrated pfu) threshold.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electron flux and Met Office REFM output showing low levels of activity.

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